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(54) Title: ACID-STABILIZED FOOD PRODUCTS

(57) Abstract

An acid-stabilized foodstuff is prepared with at least one polymeric food-acceptable acid.

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+ BESTIMMUNGEN DER "SU"

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ACID-STABILIZED FOOD PRODUCTS

FIELD OF THE INVENTION

This application is a continuation-in-part of U.S. application Serial No. 576,010, filed on August 31, 1990. The present invention relates to acid-stabilized food products and to processes for the preparation of the acid-stabilized food products.

BACKGROUND OF THE INVENTION

Fresh food products have an appealing taste, color and texture. However, a major drawback of these fresh products is that they spoil rapidly if not used immediately. Fresh food products are usually meant to be purchased, prepared if desired, and consumed in a short period of time. Often, fresh food products are refrigerated as a way of prolonging freshness. But, even at low storage temperatures, many fresh food products have a very limited term.

In fact, from the moment of harvest, food undergoes progressive deterioration and preventative measures must be taken to prolong storage life. Food preservation techniques attempt to retain the food's nutritional value and to prolong the stability of the food's organoleptic properties.

Methods of preservation involve the application of scientific and engineering principles to control food deterioration. Modern processes to achieve food preservation are aimed primarily at controlling the growth of microorganisms.

Drying is one of the oldest methods of food preservation known. Sun drying of fruits, nuts and grains, meats and vegetables is an important method of food preservation. However, since the natural elements are unpredictable, mechanical dehydration equipment is

used to maximize heat transfer into the product and afford greater control of the drying variables. Commercially used dried foods include apples, apricots, figs, prunes, raisins, carrots, potatoes, bananas, eggs, and milk. Most dried foods have excellent shelf life, are reasonably inexpensive, and, because of convenience, have widespread use in the food service industry.

Fresh food products also have been prepared or even precooked and provided in cans. Canned products such as vegetables typically are prepared as follows: blanching the vegetables in boiling water to soften the vegetables; filling the blanched vegetables into a can together with a sauce or syrup if desired; sealing the can; and retorting the sealed can under time-temperature conditions sufficient to provide a sterile product - typically about one hour at 115°C. Since the canned product and its environment typically have a water content which will support the growth of spoilage organisms, the canned product must be subjected to relatively severe heat processing conditions in order to produce a sterile product. The product is then maintained in the sterile state, by sealing it in the can. This protects against microorganism-spoilage and makes a commercially feasible product. Processing under these severe conditions, however, results in a taste and texture which is less than optimal, and often limits the acceptability of the canned products.

Food products are also available in a frozen state which can be freshly boiled, heated or cooked in the home immediately prior to consumption. However, freezing adds considerable expense to the manufacturing

and delivery costs of the products. Moreover, frozen products are perceived by many consumers to be less desirable then products prepared directly from a fresh, unfrozen product.

An approach to the problem of degradation of the color of foodstuffs has been to treat them with chemicals. For example, sulfating agents such as sulphur dioxide, sodium and potassium bisulfite, sodium and potassium metabisulfite and sodium sulfite, have been successfully used for controlling or reversing discoloration of a wide variety of foodstuffs, including fruits and vegetables, potatoes, hominy, mushrooms and soup mixes. However, the use of these sulfating agents has not been without problems. They tend to produce sulfurous odors and flavors, and though they heretofore have been generally regarded as safe, recently they have been implicated as potential health hazards (for example, as initiators of asthmatic attack and other adverse reactions in sensitive people). Also, the sodium containing agents are contraindicated with respect to hypertensive individuals.

The art has long been searching for an alternative to the foregoing. The alternative should provide a product which has an extended life at room temperature or under normal conditions of refrigeration, is easily prepared and stored, has substantially no off-flavor in a state suitable for consumption, and (when in a state suitable for consumption) is at least palatable and pleasing in appearance.

In past attempts to achieve some of these desired attributes, it has been proposed that food

products could be treated with acid to yield a suitable product.

Microorganisms are sensitive to acids in various degrees. The preserving effect of acid is due to the hydrogen ion concentration and its destabilization effect on bacterial cells. Acids may be found in foods as a natural component, produced in foods by fermentation, or added to foods directly as a chemical. Since acid enhances the lethality of heat, acid foods (pH 4.6 or below) need only be heated generally up to about 95°C which is much lower than the heat needed for more alkaline foods (low acid; pH above 4.6) to render them free of spoilage organisms. The acids commonly added to foods (acetic, citric, malic) create a distinct "pickled" flavor, which in many instances detracts from the natural home-cooked flavor. Moreover, the foods to which they have been added are technically termed acidified.

Each of the following patents discloses treating one or more foodstuffs with one or more acids:

JP 62-130644	EP 0012255	UK 2036533	DE 3624035
US 2383907	EP 201266	UK 2174588	
US 4789553	US 4181747	US 3886296	US 3985904
US 4741911	US 4542033	US 4191787	US 2291704
US 4818549	US 4740380	US 4675202	US 4564527
US 3446630	US 4814192	US 4762726	US 3366490
US 2992114	US 2790717	US 2819972	US 2819973
US 2434388			

The foodstuffs treated in these patents include such items as fruits, vegetables, meats, slurries of vegetable seed fiber, salad dressings, sauces, beverages including juices, and egg yolks. The acids used include ascorbic, acetic, citric, lactic, malic,

tartaric, fumaric, adipic, succinic, phosphoric, nitric, hydrochloric, sulphuric, levulinic, gluconic, propionic, hydroxyacetic, maleic, glutaric, palmitic, itaconic, aldonic, sorbic, cinnamic and benzohydroxamic, among others.

Also, the following patents and paper apparently use pectin, carrageenan and/or alginic acid to form gels around various foodstuffs:

JP 59-210863 EP 253535 SE 389796
JP 82-05680 EP 277448 UK 1118730
JP 81-131375 US 3991218
JP 57-26746 US 4837037
Hara, Food Industry, 1988, 31(6) 76-85.

Additionally, JP-A-6 307 770 apparently describes the preparation of a noodle which contains an acid preservative in its dough. The preservative includes a food-acceptable organic acid, a salt of such an acid and a water-soluble macromolecular polysaccharide or chitosan. The organic acid may be citric, tartaric, malic, fumaric, lactic, acetic or gluconic acid. The polysaccharide may be alginic acid or sodium alginate. However, the polysaccharide appears to be used solely as a texturizing agent. Based on an analysis of this application, it is believed that the free polysaccharide is not present as part of the final product since the polysaccharide appears to be neutralized by the organic acid salt. Moreover, there is no report of stability of the product beyond 10 days.

Thus, it can be seen that there have been many attempts to develop acid-treated products which can be stored effectively for an extended period of time. However, these attempts typically involve

treatment with conventional food acids - i.e., generally low molecular weight inorganic or organic acids - and, at least as far as is known, none has resulted in a product with all of the attributes required of a premium product, namely (i) extended life at room temperature or normally prevailing refrigeration temperatures, (ii) ease of preparation and storage, (iii) substantially no off-flavor when in a condition suitable for consumption, and (iv) when in such condition, palatability and a fresh, pleasant appearance. For example, while some conventional acid-treated products may have a somewhat extended storage- or shelf-life, they have a foreign acid taste. Indeed, it would seem to be inevitable that a product treated with acid will have an acid taste.

Provision of a premium product having the full complement of advantageous features described above would be a substantial advance over the technology discussed heretofore.

OBJECTS OF THE INVENTION

Accordingly, it is an object of the invention to provide an acid-stabilized food product.

It is an additional object of the invention to provide a food product which has an extended life at room temperature or under normal conditions of refrigeration.

It is another object of the invention to provide a food product which is easily prepared and stored.

It is still another object of the invention to provide a food product which has substantially no off-flavor.

It is a further object of the invention to provide a food product which, when in a condition suitable for consumption, is at least palatable and pleasing in appearance.

It is still a further object of the invention to provide a food product in a suitable container.

It is yet a further object of the invention to provide a method for the preparation of the above-mentioned food products.

These and other objects of the invention will be readily apparent from the following description and claims.

SUMMARY OF THE INVENTION

In one aspect, the invention is a method for the preparation of an acid-stabilized food product, which comprises treating the food product with a polymeric food-acceptable acid under conditions such that the product's life is extended without introducing foreign acid flavor notes.

In a second aspect, the invention is a method for the preparation of an acid-stabilized food product, which comprises treating a food product with at least one polymeric food-acceptable acid in an amount, for a time, and at a temperature sufficient to effect the product's acid-stabilization.

In another aspect, the invention is a method for the preparation of an acid-stabilized food product, which comprises treating a food product in an aqueous solution or suspension of at least one polymeric food-acceptable acid, and packaging the food product in a container.

In yet another aspect, the invention is an acid-stabilized food product prepared by any of the methods described above.

In still another aspect, the invention is an acid-stabilized food product which is substantially free of foreign acid flavor notes.

In a further aspect, the invention is an acid-stabilized food product, which comprises a food product having a pH below about 4.6, and at least one polymeric food-acceptable acid component.

In yet a further aspect, the invention is a system, which comprises an acid-stabilized food product having a pH below about 4.6, at least one polymeric food-acceptable acid component, and a container in which the product resides.

The food products in accordance with the present invention are advantageous in that they have the full complement of features required of a premium product, in contrast to prior products which are deficient in one or more important respects. For example, the products of the present invention are easily prepared and stored. Further, they have an extended life, and thus lend themselves to distribution, display and sale in a wide range of commercial settings, for instance in high-volume supermarkets, in convenience stores and in food-service establishments. Because of the unique attributes of the present invention, there is no need to sacrifice the taste and texture of a premium product in order to secure the versatility in adaptation to the different marketing environments described above.

Furthermore, in certain embodiments, the invention is advantageous in eliminating the need for

specialized delivery and storage conditions which result in considerable cost savings. Unlike conventional fresh and frozen products, which must be refrigerated, the products of the present invention, in these embodiments, can be held at ambient temperature for long periods of time without damaging the product or affecting its acceptability. The substantial economies resulting from obviating the need for refrigeration make the product commercially appealing from a cost standpoint.

In other embodiments, the products of the present invention can be held under refrigeration and will resist microorganism spoilage for substantially longer periods of time than are achieved with currently available conventional refrigerated products.

DESCRIPTION OF CERTAIN PREFERRED EMBODIMENTS

The acid-stabilized products of the invention, and the methods of preparing them, provide a product having the attributes of a premium product. They are preserved food products with enhanced resistance to microorganism spoilage.

Essentially any food product is considered to be usable in accordance with the invention. Specifically included are vegetables and fruits (whether or not they are processed in any way), fruit gels, egg products (including casseroles, omelettes and quiches), sauces (including tomato-based sauces, teriyaki, wine sauces, purees, gravies and sauces containing meat whether or not the meat is also acid-stabilized before being added to the sauce), grain products, soups, salad dressings, dairy-based products (cream sauces, cheeses, cheesecake, and custard), puddings (including rice puddings, noddle puddings and

breakfast puddings with cereal grains), fillings for pasta, icing, beverages (especially vegetable beverages and fruit beverages including juices), spices, extracts and cereal products. Examples of vegetables which are particularly well suited to use in accordance with the invention include carrots, zucchini, red bell peppers, onions and corn. Examples of fruits which are particularly well suited to use in accordance with the invention are cherries, blueberries, strawberries, apples, pears and peaches.

As used herein, the term "acid-stabilized food products" means food products treated with a suitable acid or acids, either in the free or dissociated state, under conditions (e.g., amount of acid, time of treatment, pH of treatment medium, temperature, etc.) such that the number of microbes destroyed in the food product is sufficient, at least under conditions of refrigeration, to result in the food product's maintaining its resistance to microorganism-spoilage for 90 days or more. Further, as used herein, to "treat" with acid(s) refers to treatment in any way suitable for effecting intimate contact between the food product and the acid(s), for example, by boiling the food product in acidified water, by incorporating the acid(s) directly in the food product during formulation, by soaking the food product in acidified water, some combination of two or more of those measures, or the like.

For purposes of this invention, a product is considered to be "shelf-stable" when that product remains of acceptable quality from the time of manufacture until the anticipated time of consumption without means of preservation such as refrigeration.

While a shelf-life of even 3 or 4 months would be acceptable under certain circumstances, typically, ready-to-eat products are considered to be shelf-stable if they remain of acceptable quality for at least 9 months, preferably at least 12 months, and especially at least 14 months. Sensory attributes of particular interest in assessing shelf-stability are color, texture, aroma, flavor, rancidity and tartness. A product is shelf-stable when these attributes are of acceptable quality after passage of the desired time. In particular, the growth of spoilage microorganisms should be inhibited in a shelf-stable product and this minimization over long periods of time is the hallmark of shelf-stability.

By "precooked" is meant that the food product can be prepared for consumption merely by heating it, for instance in a conventional oven or a microwave oven, or by steaming it or immersing it in hot or boiling water, to elevate the food product to a desired temperature for consumption. In a precooking step, the product is cooked for a sufficient time such that no prolonged heat treatment will be necessary in order to complete the cooking for consumption. This step can be carried out either in water or in an aqueous solution or suspension of acid.

Typically, the precooked product is reheated for a time of 30 seconds to 3 minutes. For example, in certain embodiments the product is heated in a microwave oven for a short time, e.g., about two minutes. In this way, if the product is heated in final preparation for dining, so little heating is necessary that essentially no further cooking occurs. However, in certain advantageous embodiments, since the

precooked product is already fully cooked and ready to eat from the container, it can be used at room-temperature or in a cold salad with no heating.

In still another advantageous embodiment, however, the product simulates fresh, refrigerated product and is not fully cooked.

Thus, in certain embodiments of the invention, the food product is pre-cooked or at least cooked partially during preparation for storage and display pursuant to marketing. In these embodiments, the acid-stabilization of the product typically renders it shelf-stable. However, in other embodiments, the food product simulates a fresh refrigerated product, and there is no cooking prior to distribution into marketing channels. The food products in such cases is advantageously refrigerated, and under those conditions exhibits an extended life vis-a-vis conventional refrigerated products.

An essential feature of the present invention is the utilization of at least one polymeric, typically macromolecular, food-acceptable acid. Typically, these acids are of high molecular weight, for example, having a subunit molecular weight of about 190, and can be copolymeric substances if desired. Of course, they are non-toxic, and additionally are materials which have the capability of retarding growth of spoilage micro-organisms without imparting a foreign acidic or other undesirable "off" flavor to the product.

The preferred polymeric food-acceptable acids have a cellulosic or saccharide-derived backbone with pendent carboxyl groups. A preferred polymeric acid in accordance with the invention is alginic acid; also preferred are the non-alginic polymeric food-acceptable

acids such as carrageenic acid, pectinic acid, and carboxymethyl cellulose acid. Combinations of two or more of the foregoing acids can also be utilized.

The acid is used in an amount sufficient to attain conditions which result in the treated product's exhibiting the desired shelf-life or extended life, and one or more other attributes of a premium product without imparting foreign acid flavor notes. It can be appreciated that the precise quantity of acid utilized in any particular embodiment will often depend on other considerations, such as the nature of the final product desired (for example, refrigerated but not necessarily shelf-stable, or non-refrigerated and substantially shelf-stable, etc.), the amount and type of food product, the pH desired, other substances present, etc. For example, when the product is a precooked product which is precooked by boiling, the acid can be present in an amount of from about .05 to 2 wt.% of the cooking medium or brine. However, the quantity can vary from one embodiment to another, and its determination is empirical. It is, in any event, within the capability of one ordinarily skilled in the art, once equipped with the teachings set forth herein, to determine the amount of acid which is needed.

While the polymeric food-acceptable acid may be introduced as such, it can alternatively be generated in situ, for instance, by reaction between a salt of the polymeric acid and an inorganic acid. For instance, alginic acid may be generated by reacting sodium alginate with hydrochloric acid.

Additionally, derivatives of the acid may be used in place of the acid, or derivatives of the acid may be formed during cooking and be present in the

product. All these embodiments are contemplated herein.

That the use of a polymeric food-acceptable acid enables food products to be made shelf-stable, and have all the other attributes required of a premium product, is surprising for a number of reasons. For example, previously proposed procedures which used an acid have all resulted in products which do not have all the attributes required of a premium product. One typical failing is that the acids used impart an unpalatable foreign acid taste to the product. However, this failing is remedied by the present invention.

The suitability of polymeric food-acceptable acids is additionally surprising since, as far as is known, these acids have never before been successfully used as acidulants for food products. The aforementioned Japanese patent application, JP-A-6 307 770, apparently discloses use of polysaccharides, but not as acidulants. Rather, they are believed to be used as texturizing agents, and are not believed to survive processing. Other uses of the polymeric acids, and their sodium or calcium salts, are as thickening agents or coatings in food products. Also, alginates have been used as stabilizers in ice cream, water ices, sherbets and cheese, as gelling agents in water dessert gels and milk puddings, as suspending and thickening agents in fruit drinks and beverages, as foam stabilizers in beer, as emulsifiers in salad dressings and as film forming agents in coatings for meat and fish. Additionally, U.S. Patent No. 3,332,786 apparently discloses that propylene glycol alginate "stabilizes" starch. (The specific starches mentioned

are natural or modified starches derived from corn, wheat, potatoes, waxy maize and tapioca). However, this stabilization relates to the ability to withstand freeze-thaw cycles or gelling problems. It does not relate to, nor was it recognized as having any ability to providing, shelf-stability or other extension of product life as discussed herein.

Thus, the prior art provides no suggestion that such polymeric food-acceptable acids could be used as acidulants, let alone with the surprising results shown by the present invention.

Moreover, these polymeric acids are generally only sparingly soluble in water. For this reason, it is surprising that they can act as acidulants at all. It is further unexpected that they can produce the required acidification to produce a stable product without the use of undesirably large quantities of the acid.

In certain advantageous embodiments, one or more conventional acidulants is utilized in addition to the polymeric acid. The conventional acidulants will be used to assist in controlling the pH of the product at the desired level. Typically, the conventional acidulant is present in a brine for cooking the product, in an amount of about .25%. However, in some embodiments, the conventional acidulant is incorporated in the product formulation. In certain embodiments, the conventional acidulant replaces some of the polymeric food-acceptable acid which would otherwise be needed. However, it should be ensured that the amount of conventional acidulant used is not so large as to impart an unacceptable flavor to the product, and that the amount of polymeric food-acceptable acid is not

decreased to the extent that the advantages of the invention are lost.

Suitable conventional acidulants include inorganic acids, such as phosphoric, sulfuric and hydrochloric acids, and organic acids, such as citric, malic, acetic, fumaric, tartaric, adipic, lactic, ascorbic, sorbic, propionic and erythrobic acids. Citric acid is especially preferred, but malic and ascorbic acids are also preferred.

To measure the pH of the product, a known amount of the product, for example a 100 gram sample, is combined with an equivalent weight of distilled water in a blender until a homogeneous paste is achieved. Electrode tips are immersed in the paste while the paste is stirred. The electrode is allowed to stabilize for one minute before the pH reading is taken.

Treatment of the food products in accordance with the invention varies as appropriate with the particular food product to be acid-stabilized. Thus, in accordance with certain embodiments of the invention, and particularly for treating a food product such as vegetables and fruits, the food product is precooked, typically by boiling it to bring it to the desired state of preparation. However, boiling is not necessary and the product may be precooked at temperatures below 100°C. In certain embodiments, the temperature is between 90°C and 100°C, preferably about 95°C. When it is expected that significant heat-exposure will be necessary in subsequent processing steps, such as pasteurization or other stabilization, the extent of prior partial cooking - e.g., cooking time and/or temperature - is commensurately less.

Typically, the product is precooked (including any pasteurization or other stabilization) for about 5-30 minutes, especially 7-16 minutes, for instance by boiling in an aqueous solution or suspension of at least one polymeric food-acceptable acid. The aqueous solution or suspension typically has a pH from about 2.0-4.0, especially 2.4-2.8. However, the exact time, pH, temperature and other conditions of precooking can vary from one embodiment to another, and the skilled artisan will be able to derive the particular precooking parameters best suited to the situation empirically, based on his level of skill and the teachings set forth herein. For example, it will be appreciated that the cooking times of the product will vary depending on the size, thickness and shape of the product and the degree to which it is precooked. Further guidance regarding suitable conditions to be used can be obtained from a study of the examples set forth hereinafter. Given the above disclosure and the examples, one skilled in the art will be able to determine appropriate conditions for processing the food products.

Salt and/or sugar, and other flavorings, for example at about 1 to 2% each, can also be used in the cooking medium or brine.

If desired, the product can be quenched after the initial treatment, typically at room temperature. It is preferred that the product be quenched, in an aqueous solution or suspension of at least one polymeric food-acceptable acid as already described, after heating in connection with precooking or partial cooking. A quenching liquid can also advantageously contain one or more conventional acidulants (also as

already described) besides the polymeric acid. Whether or not a quenching liquid is used, the product can be washed (for instance in water) between steps and separated from, e.g. drained of, all free liquid prior to packaging or at least prior to sealing the container.

Further, if desired, the foodstuff can be contacted with an amount of edible oil sufficient to prevent the foodstuff from sticking together. Typically, the edible oil is used in an amount of from about 0.5 to 1% by weight of the product. Examples of the oils include rice oil, sunflower oil, soybean oil, cottonseed oil, or rapeseed oil.

In any event, after processing, the pH of the product in the preferred embodiments should be below about 4.6. This is the generally recognized maximum pH which ensures that the pasteurized product remains shelf-stable. Typically, the pH of the product is in the range of about 3.8 to 4.6, preferably 3.8 to 4.2. In one preferred embodiment, the pH of the product is about 4.0. The pH can be below 3.8. However, the lower the pH, the more acid must be used and the more difficult it is to avoid acid flavor in the product. As a practical matter, the skilled person given the instant disclosure will be able to balance the pH level and amount of acid used to ensure that the product is shelf-stable and has substantially no foreign acid flavor notes.

Of course, in other embodiments, it is desired to produce a product simulating a fresh product, especially fresh fruits and vegetables. This can be achieved, for example, by soaking the product in an aqueous solution or suspension of acid to effect

a product-pH low enough to result in the product's maintaining its resistance to microorganism spoilage for 90 days or more. For these embodiments, the pH of the product can be less than about 4.6, but can alternatively be higher, for example as high as 6.0, if the product is refrigerated or some analogous preservative measure is taken. It is within the skill of the art to derive the parameters best suited to the situation. For example, a higher pH could be employed if the life of the product need not be greatly extended. In these embodiments, too, the product typically is also pasteurized by passing it through a steam tunnel so that its center temperature is held at about 95°C for about 5 minutes.

In still other embodiments, it is desired to incorporate the acid in the product formulation. This is particularly useful for acid-stabilizing sauces, salad dressings, puddings, soups, vegetable beverages, fruit beverages, dairy-based products and egg-based products. The acid is incorporated into the product formulation in an amount sufficient to effect a product-pH low enough to result in the product's maintaining its resistance to microorganism spoilage for 90 days or more. The pH of these products also can be less than about 4.6, but can alternatively be higher, for example as high as 6.0, if the product is to be refrigerated or some analogous preservative measure is taken. It is within the skill of the art to derive the parameters best suited to the situation.

The products of the present invention are then typically packaged in a container having a configuration, construction and constituent material such that it is capable of maintaining the acid-

stabilized product - i.e., providing an environment in which the product's shelf-stability or extended life due to acid-stabilization is not appreciably diminished by extraneous influences for substantially the entire period of its shelf-stability or extended life. During packaging, in certain embodiments, the product is first cooled. The package is advantageously a container made of a microorganism-impermeable and/or waterproof material, for example glass, foil or a suitable plastic, and in some embodiments it is a container (for example, a pouch) made of oxygen-impermeable material. Such containers include, for example, cans, jars, bottles, foil trays, plastic trays, foil pouches and plastic pouches. The containers may be flexible or rigid. A particularly preferred container is a plastic tray, advantageously used with a foil or plastic lid. The plastic may be a single layer or, preferably a laminated material comprising a reinforcing layer, such as a nylon or polyester layer, and a sealing layer such as a polyethylene, polyvinylidene chloride or EVOH layer, for instance nylon/polyethylene or polyester/polyethylene. Alternatively, the package can be a laminate of board and plastics material, such as that sold by Combibloc. The advantage of packaging the products of the invention in plastic materials is that the products can be reheated in a microwave oven without the need to decant it before reheating.

In one embodiment, the products are packaged in the container under vacuum prior to pasteurization or other processing in connection with partial cooking (in which case the container is capable of withstanding heating attendant to such pasteurization or other processing). In other embodiments, the products of the

present invention are preferably packed in the container under an inert gas atmosphere, for example, to avoid any discoloration of the product by oxidation during pasteurization, other processing, storage or display. Typically, the container is flushed with an inert gas, and then the container is sealed and sterilized. Any suitable, non-toxic inert gas can be used, but nitrogen and especially carbon dioxide or mixtures of nitrogen and carbon dioxide are preferred. Typically, the atmosphere within the container is substantially free of oxygen. The package can be hermetically sealed.

The use of carbon dioxide is particularly advantageous in certain embodiments because it should provide further protection against spoilage. For instance, if the product of the present invention is subjected to such conditions as would allow water to gather in the package, such water could provide a breeding ground for microorganisms. However, if the product is packed in a carbon dioxide atmosphere, the gas will dissolve in free water present. This makes the water a much less conducive environment for growth of microorganisms. In other embodiments, food grade diatomic nitrogen is advantageously employed. By this measure, CO_2 produced by spoilage microorganisms will not be masked by CO_2 introduced as the inert atmosphere, and the detection of CO_2 will be an indication of the presence of such microorganisms.

The packaging often includes substantially evacuating the container for holding the product, i.e., so that the air content in the container does not exceed 5%. In certain embodiments, pasteurization is

effected by holding the product in the sealed container at a temperature of about 85°C, for example, about six minutes in steam for a pack 20mm thick, followed by drying and cooling. When the product in the package is cool, reheating to the temperature mentioned above can be effected with steam or in hot water. Alternatively, the product may be pasteurized or otherwise processed in connection with partial cooking before the package is sealed.

In those embodiments of the invention which include a pasteurization step, sometimes herein referred to as acid-pasteurization, the minimum requirements are that the center temperature of the food should be held for a time sufficient to achieve killing of microorganisms. Typically, the center temperature of the food is held at a minimum of about 85°C for at least about five minutes, and the food should have a pH less than 4.6. If higher temperatures or lower pHs are used, then the treatment time may be reduced. However, it is preferred that, as a minimum, the pasteurization step, whatever the pH, should hold a center temperature of 85°C for five minutes. More preferably, a center temperature of 93°C should be held for 10 minutes. Generally, if the pasteurization step is carried out at a temperature of 100°C or less, it is not necessary to use a pressurized heating system. The pasteurization step can be carried out under atmospheric pressure using hot water or steam to heat the product. If the pasteurization step is carried out at a temperature above 100°C, then the use of a pressurized system will prevent water from being driven off. In any event, the product is pasteurized while it is maintained at a pH of less than 4.6 by the use of

the aqueous solution or suspension of at least one polymeric food-acceptable acid.

Accordingly, however treated, the finished product in the preferred embodiments of the invention typically have a pH below about 4.6. Preferably, the products have a pH from about 3.8 to 4.2. In particular, the products have a pH of about 4.0. Additionally, the products typically contain a characteristic acid component. This component preferably is included in an amount of approximately 0.05% -2% (w/w), and especially 0.6% (w/w).

The acid component in the product includes any residue or moiety of the acid molecule which is present in the treated product and is a reflection of the fact that the product has been treated.

As described, the product of the invention has the full complement of advantages and features that should be demanded of a premium product, namely (i) extended life at room temperature or normally prevailing refrigeration temperatures, (ii) ease of preparation and storage, (iii) substantially no off-flavors when in a condition suitable for consumption, and (iv) palatability and a fresh, pleasant appearance.

The present invention is further described and illustrated in the following examples. It will be appreciated that these examples are provided solely for the purposes of illustrating the invention and not for the purpose of limitation. It will further be appreciated that variations and modifications to the product and process can be made by the skilled person without departing from the spirit or scope of the invention as defined in the appended claims.

Examples 1 and 2

A 500 gram sample of a vegetable blend which includes chopped zucchini, carrots and red bell peppers in the relative ratios of 55:45:10 is used in these examples. Each sample is blanched at 90°F for 5 minutes. The blanching solution contains (in grams):

Ex.	Water	Sugar	Salt	Calcium Chloride	Tartaric Acid	Ascorbic Acid	Alginic Acid
1	3573.4	327.0	62.0	17.6			20.0
2	3573.4	327.0	62.0	17.6	5.2	4.4	10.4

After blanching, each sample is quenched in the blanching solution at room temperature for 20 minutes, and then rinsed with water for 1 minute. The pH of the treated vegetable blend in Example 1 is 3.45, and in Example 2 is 3.68.

When reheated, the vegetable blend has organoleptic properties similar to a vegetable blend cooked in a conventional manner by boiling in water.

Example 3

A 1100 gram sample of the following chopped vegetable blend is used in this sample:

zucchini	550g
carrots	450g
red bell peppers	100g
	1100g

The sample is blanched at 90°F for 5 minutes; drained for 1 minute; and held for 20 minutes in the blanching solution at room temperature. The blanching solution contains (in grams):

Water	Sugar	Salt	Calcium Chloride	Alginic Acid
3640.8	261.6	62.0	17.6	18.0

The ph of the treated vegetable blend is 3.47.

When reheated, the vegetable blend has organoleptic properties similar to a vegetable blend cooked in a conventional manner by boiling in water.

Example 4

A chopped vegetable blend which includes 49.2% zucchini, 41.5% carrots and 9.3% red bell peppers is prepared and treated under the same condition as in Example 3 with the following blanching solution:

Water	Sugar	Salt	Alginic Acid	Calcium Chloride
91.00%	6.56%	1.55%	0.45%	0.44%

The treated vegetable blend is combined with creamy Italian Dressing in a jar, and the jar is nitrogen flushed before sealing. The pH of the vegetables and dressing is less than 4.0. The mixed product has organoleptic properties similar to other non-treated products of the same type.

Example 5

A chicken gravy of the following formulation is prepared:

Water	87.14%
Modified Starch	3.46%
Margarine	3.05%
Chicken Flavor	2.96%
Flour	2.14%
Emulsifier	0.44%
Dairy Solids	0.33%
Food Gum	0.25%
Salt	0.17%
Spice	0.17%
	100.00%

A second formulation is prepared with the addition of 0.200% alginic acid.

The first formulation is processed under full retort conditions at 115°C to achieve commercial sterility. The pH of the product is 6.20.

The second formulation is processed under pasteurization conditions at 93°C for acidified products to achieve commercial sterility. The pH of the product is 4.11.

The second formulation shows significant improvement in color due to reduced processing conditions, and no significant acidic notes are detectable.

Example 6-8

The following cheesecake formulations are prepared (weight is in grams):

Ex.	Eggs	Cream Cheese	Alginic Acid	Lemon Juice	HCl 1N	Sugar	Salt	Swiss Cheese	Graham Crumbs
6	254	200	9.0	5.8	50	150	0.5	---	3.0
7	254	---	9.0	5.8	50	150	0.5	200	3.0
8	254	200	9.0	5.8	50	150	0.5	---	3.0

To prepare the cheesecake, the cheese is softened and blended thoroughly with the eggs. The acids and lemon juice are mixed and then thoroughly combined with the egg mixture. The sugar and salt are added and the mixture is blended. Finally, the mixture is poured into trays. Graham crumbs are sprinkled over the top. The product is packaged and pasteurized.

The pH of the product after processing is 2.7 for Trial 1, 4.2 for Trial 2 and 2.66 for Trial 3.

The resulting product has an excellent flavor and texture, and the organoleptic properties in general are similar to a conventional product.

Examples 9-12

Sliced potatoes are blanched at 90° C in the following blanching solutions (weight in grams):

Trial	Water	Alginic Acid	Citric Acid	Potatoes	Blanch Time	Final pH
1	4000	60	4	200	17	4.18
2	4000	50	--	500	45	4.8
3	4000	12	10	400	10	4.8
4	4000	12	10	400	12	4.8

(The samples in Trials 3 and 4 were quenched in 4000g water and 12g alginic acid for 2 minutes after blanching.)

The resulting sliced potatoes had organoleptic properties similar to potatoes cooked in a conventional manner by boiling in water.

The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention in the use of such terms or expressions of excluding any equivalents of the features shown and described as portions thereof, its being recognized that various modifications are possible within the scope of the invention.

WE CLAIM:

1. A method for the preparation of an acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, which comprises treating the foodstuff with an amount of a polymeric food acceptable acid sufficient to effect acid-stabilization.
2. A method for the preparation of an acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, which comprises treating the foostuff with at least one polymeric food-acceptable acid in an amount, for a time, and at a temperature sufficient to effect the foostuff's acid-stabilization.
3. A method as defined in claim 2, wherein the polymeric food-acceptable acid is alginic acid.
4. A method as defined in claim 2, which comprises cooking said foodstuff in an aqueous solution or suspension of said polymeric food-acceptable acid.
5. A method as defined in claim 4, wherein said aqueous solution or suspension of at least one polymeric food-acceptable acid has a pH from about 2.4 to 2.8.
6. A method as defined in claim 4, wherein at least one other food-acceptable acid is dissolved or suspended in the aqueous solution or suspension of at least one polymeric food-acceptable acid.

7. A method as defined in claim 6, wherein each said other food-acceptable acid is selected from the group consisting of citric, malic, acetic, fumaric, tartaric, phosphoric, adipic, lactic, ascorbic, sorbic, propionic, erythorbic, sulfuric and hydrochloric acids.
8. A method as defined in claim 7, which comprises cooking said foodstuff in an aqueous solution or suspension of at least one polymeric food-acceptable acid and of at least citric acid.
9. A method as defined in claim 4, which further comprises quenching said cooked foodstuff in an aqueous solution or suspension of at least one polymeric food-acceptable acid.
10. A method as defined in claim 9, wherein the polymeric food-acceptable acid used for quenching is alginic acid.
11. A method as defined in claim 9, wherein at least one other food-acceptable acid is dissolved or suspended in the aqueous solution or suspension of at least one polymeric food-acceptable acid used for quenching.
12. A method as defined in claim 11, wherein each said other food-acceptable acid dissolved or suspended in the aqueous solution or suspension used for quenching is selected from the group consisting of citric, malic, acetic, fumaric, tartaric, phosphoric, adipic, lactic, ascorbic, sorbic, propionic, erythorbic, sulfuric and hydrochloric acids.
13. A method as defined in claim 4, which comprises subjecting the foodstuff to processing conditions such that it is in the acid-pasteurized state.

14. A method as defined in claim 4, which comprises subjecting the foodstuff to processing conditions such that it is in the precooked state.
15. A method as defined in claim 2, which comprises treating said foodstuff such that it has a pH below about 4.6.
16. A method as defined in claim 15, which comprises cooking said foodstuff in an aqueous solution or suspension of at least one polymeric food-acceptable acid under conditions such that said foodstuff has a pH from about 3.8 to 4.2.
17. A method as defined in claim 16, which comprises cooking said foodstuff under conditions such that said foodstuff has a pH of about 4.0.
18. A method as defined in claim 4, which further comprises separating said cooked foodstuff from residual solution or suspension.
19. A method as defined in claim 4, which further comprises contacting said cooked foodstuff with an amount of edible oil sufficient to prevent the foodstuff from sticking together.
20. A method as defined in claim 19, wherein said amount of edible oil is from about 0.5 to 1% by weight of the foodstuff.
21. A method as defined in claim 2, which comprises treating the foodstuff with an aqueous solution or suspension of at least one polymeric food-acceptable acid for a time and at a temperature sufficient to effect acid-stabilization, and packaging the foodstuff in a container.
22. A method as defined in claim 20, which comprises subjecting the foodstuff to conditions such that

the foodstuff in the package is in the precooked state.

23. A method as defined in claim 21, wherein said packaging step comprises inserting a measured amount of said foodstuff into a container, flushing the container with an inert gas, sealing said container and sterilizing the contents thereof.

24. A method as defined in claim 21, wherein said container is microorganism-impermeable, waterproof, or both microorganism-impermeable and waterproof.

25. A method as defined in claim 21, wherein said container is a plastic tray or pouch.

26. A method as defined in claim 25, wherein said plastic tray or pouch comprises a laminate of a reinforcing layer and a sealing layer.

27. A method as defined in claim 21, wherein said packaging step comprises substantially evacuating a container for holding the foodstuff.

28. A method as defined in claim 21, wherein the conditions of treatment are sufficient to effect acid-pasteurization.

29. A method as defined in claim 2, which comprises introducing the foodstuff into a container after contacting it with an aqueous solution or suspension of at least one polymeric food-acceptable acid; sealing the container; and heating the contents of the container such that the foodstuff's acid-stabilization is effected.

30. A method as defined in claim 29, wherein said foodstuff is partially cooked prior to its introduction into the container.

31. A method as defined in claim 29, which comprises subjecting the foodstuff to conditions such that its acid-pasteurization is effected.
32. An acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, prepared by the method which comprises treating the foodstuff with a polymeric food-acceptable acid under conditions such that the foodstuff is acid-stabilized.
33. An acid-stabilized foodstuff as defined in claim 32, wherein said polymeric food-acceptable acid is alginic acid.
34. An acid-stabilized foodstuff as defined in claim 32, wherein said method comprises cooking said foodstuff in an aqueous solution or suspension of said polymeric food-acceptable acid.
35. An acid-stabilized foodstuff as defined in claim 34, wherein said aqueous solution or suspension of at least one polymeric food-acceptable acid has a pH from about 2.4 to 2.8.
36. An acid-stabilized foodstuff as defined in claim 34, wherein said acid is alginic acid.
37. An acid-stabilized foodstuff as defined in claim 34, wherein at least one other food-acceptable acid is dissolved or suspended in the aqueous solution or suspension of at least one polymeric food-acceptable acid.
38. An acid-stabilized foodstuff as defined in claim 34, wherein the foodstuff is subjected to conditions such that it is in the acid-pasteurized state.

39. An acid-stabilized foodstuff as defined in claim 34, wherein the foodstuff is subjected to conditions such that it is in the precooked state.
40. An acid-stabilized foodstuff as defined in claim 34, wherein said cooking is under conditions such that said foodstuff has a pH below about 4.6.
41. An acid-stabilized foodstuff as defined in claim 40, wherein said cooking is under conditions such that said foodstuff has a pH from about 3.8 to 4.2.
42. An acid-stabilized foodstuff as defined in claim 41, wherein said cooking is under conditions such that said foodstuff has a pH of about 4.0.
43. An acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, which is substantially free of any foreign acid flavor notes.
44. An acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, which has a pH of 6.0 or below, and includes at least one polymeric food-acceptable acid component.
45. A shelf-stable foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, which has a pH below

about 4.6, and at least one polymeric food-acceptable acid component.

46. A shelf-stable foodstuff as defined in claim 45, wherein said foodstuff has a pH from about 3.8 to 4.2.

47. A shelf-stable foodstuff as defined in claim 45, wherein said foodstuff has a pH of about 4.0.

48. A shelf-stable foodstuff as defined in claim 45, which is in the precooked state.

49. A shelf-stable foodstuff as defined in claim 45, wherein each polymeric food-acceptable acid is selected form the group consisting of alginic acid, pectinic acid, carrageenic acid and carboxymethylcellulose acid.

50. A shelf-stable foodstuff as defined in claim 49, wherein said polymeric food-acceptable acid is alginic acid.

51. A shelf-stable foodstuff as defined in claim 45, which further comprises at least one other food-acceptable acid component.

52. A shelf-stable foodstuff as defined in clam 51, wherein each said other food-acceptable acid component is selected form the group consisting of citric, malic, acetic, fumaric, tartaric, phosphoric, adipic, lactic, ascorbic, sorbic, propionic, erythorbic, sulfuric and hydrochloric acids.

53. A shelf-stable foodstuff as defined in claim 51, which has a pH below about 4.6, and at least one polymeric food-acceptable acid component as well as at least a citric acid component.

54. A shelf-stable foodstuff as defined in claim 45, which further comprises an amount of edible oil

sufficient to prevent the foodstuff from sticking together.

55. A shelf-stable foodstuff as defined in claim 54, wherein said amount of edible oil is from about 0.5 to 1% by weight of the foodstuff.

56. A system which comprises an acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, which is substantially free of foreign acid flavor notes, and a container in which the foodstuff resides.

57. A system which comprises an acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, having a pH of 6.0 or below, and including at least one polymeric food-acceptable acid component, and a container in which the foodstuff resides.

58. A system which comprises a shelf-stable foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, having a pH below about 4.6, and at least one polymeric food-acceptable acid component, and a container in which the foodstuff resides.

59. A system as defined in claim 58, wherein said foodstuff has a pH from about 3.8 to 4.2.

60. A system as defined in claim 59, wherein said foodstuff has a pH of about 4.0.
61. A system as defined in claim 58, wherein each polymeric food-acceptable acid is selected from the group consisting of alginic acid, pectinic acid, carrageenic acid and carboxymethyl cellulose acid.
62. A system as defined in claim 58, wherein said foodstuff includes an alginic acid component.
63. A system as defined in claim 58, which further comprises at least one other food-acceptable acid component.
64. A system as defined in claim 63, wherein each said other food-acceptable acid component is selected from the group consisting of citric, malic, acetic, fumaric, tartaric, phosphoric, adipic, lactic, ascorbic, sorbic, propionic, erythorbic, sulfuric and hydrochloric acids.
65. A system as defined in claim 58, wherein said other food-acceptable acid component includes citric acid.
66. A system as defined in claim 58, wherein said container is microorganism-impermeable, waterproof, or both microorganism-impermeable and waterproof.
67. A system as defined in claim 58, wherein said container is a plastic tray or pouch.
68. A system as defined in claim 67, wherein said plastic pouch comprises a laminate of a reinforcing layer and a sealing layer.
69. A system as defined in claim 58, wherein the foodstuff is under vacuum within the container.

70. A system as defined in claim 58, wherein the foodstuff resides in an inert atmosphere within the container.

71. An acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, prepared by acidifying the foodstuff with an aqueous solution or suspension of at least one polymeric food-acceptable acid in a quantity sufficient to provide said foodstuff having a pH below about 4.6.

72. An acid-stabilized foodstuff as defined in claim 71, wherein said at least one polymeric food-acceptable acid is present in the foodstuff.

73. An acid-stabilized foodstuff as defined in claim 71, further prepared by heat-pasteurizing the foodstuff.

74. An acid-stabilized foodstuff as defined in claim 72, further prepared by heat-pasteurizing the foodstuff.

75. A method for the preparation of an acid-stabilized foodstuff selected from the group consisting of processed vegetables and fruits, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, which comprises introducing said polymeric food-acceptable acid during formulation of the foodstuff.

76. A method as defined in claim 75, further comprising heat-pasteurizing the foodstuff.

77. A method of preparing a foodstuff for consumption, which comprises heating a product as defined in claim 43.

AMMENDED CLAIMS

[received by the International Bureau on 2 April 1992 (02.04.92); original claims 1, 2, 13-15, 21-23, 29-32, 38, 39, 43-45, 48, 56-58, 71 and 75 ammended;other claims unchanged (11 pages)]

WE CLAIM:

1. A method for the preparation of an acid-stabilized foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, which comprises treating the foodstuff with an amount of a polymeric food acceptable acid sufficient to effect acid-stabilization.

2. A method for the preparation of an acid-stabilized foodstuff selected from the group consisting of processed vegetables, procssed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, which comprises treating the foostuff with at least one polymeric food-acceptable acid in an amount, for a time and at a temperature sufficient to effect the foostuff's acid-stabilization.

3. A method as defined in claim 2, wherein the polymeric food-acceptable acid is alginic acid.

4. A method as defined in claim 2, which comprises cooking said foodstuff in an aqueous solution or suspension of said polymeric food-acceptable acid.

5. A method as defined in claim 4, wherein said aqueous solution or suspension of at least one polymeric food-acceptable acid has a pH from about 2.4 to 2.8.

6. A method as defined in claim 4, wherein at least one other food-acceptable acid is dissolved or suspended in the aqueous solution or suspension of at least one polymeric food-acceptable acid.

7. A method as defined in claim 6, wherein each said other food-acceptable acid is selected from the group consisting of citric, malic, acetic, fumaric, tartaric, phosphoric, adipic, lactic, ascorbic, sorbic, propionic, erythorbic, sulfuric and hydrochloric acids.
8. A method as defined in claim 7, which comprises cooking said foodstuff in an aqueous solution or suspension of at least one polymeric food-acceptable acid and of at least citric acid.
9. A method as defined in claim 4, which further comprises quenching said cooked foodstuff in an aqueous solution or suspension of at least one polymeric food-acceptable acid.
10. A method as defined in claim 9, wherein the polymeric food-acceptable acid used for quenching is alginic acid.
11. A method as defined in claim 9, wherein at least one other food-acceptable acid is dissolved or suspended in the aqueous solution or suspension of at least one polymeric food-acceptable acid used for quenching.
12. A method as defined in claim 11, wherein each said other food-acceptable acid dissolved or suspended in the aqueous solution or suspension used for quenching is selected from the group consisting of citric, malic, acetic, fumaric, tartaric, phosphoric, adipic, lactic, ascorbic, sorbic, propionic, erythorbic, sulfuric and hydrochloric acids.
13. A method as defined in claim 4, which comprises subjecting the foodstuff to processing conditions such that the foodstuff is in an acid-pasteurized state.

14. A method as defined in claim 4, which comprises subjecting the foodstuff to processing conditions such that the foodstuff is in a precooked state.
15. A method as defined in claim 2, which comprises treating said foodstuff such that the foodstuff has a pH below about 4.6.
16. A method as defined in claim 15, which comprises cooking said foodstuff in an aqueous solution or suspension of at least one polymeric food-acceptable acid under conditions such that said foodstuff has a pH from about 3.8 to 4.2.
17. A method as defined in claim 16, which comprises cooking said foodstuff under conditions such that said foodstuff has a pH of about 4.0.
18. A method as defined in claim 4, which further comprises separating said cooked foodstuff from residual solution or suspension.
19. A method as defined in claim 4, which further comprises contacting said cooked foodstuff with an amount of edible oil sufficient to prevent the foodstuff from sticking together.
20. A method as defined in claim 19, wherein said amount of edible oil is from about 0.5 to 1% by weight of the foodstuff.
21. A method as defined in claim 2, which comprises treating the foodstuff with an aqueous solution or suspension of at least one polymeric food-acceptable acid under conditions of treatment for a time and at a temperature sufficient to effect acid-stabilization, and packaging the foodstuff in a container.
22. A method as defined in claim 20, which comprises subjecting the foodstuff to conditions such that the foodstuff in the package is in a precooked state.

23. A method as defined in claim 21, wherein said packaging step comprises inserting a measured amount of said foodstuff into a container, flushing the container with an inert gas, sealing said container and sterilizing the foodstuff in the container.

24. A method as defined in claim 21, wherein said container is microorganism-impermeable, waterproof, or both microorganism-impermeable and waterproof.

25. A method as defined in claim 21, wherein said container is a plastic tray or pouch.

26. A method as defined in claim 25, wherein said plastic tray or pouch comprises a laminate of a reinforcing layer and a sealing layer.

27. A method as defined in claim 21, wherein said packaging step comprises substantially evacuating a container for holding the foodstuff.

28. A method as defined in claim 21, wherein the conditions of treatment are sufficient to effect acid-pasteurization.

29. A method as defined in claim 2, which comprises introducing the foodstuff into a container after contacting the foodstuff with an aqueous solution or suspension of at least one polymeric food-acceptable acid; sealing the container; and heating the contents of the container such that the foodstuff's acid-stabilization is effected.

30. A method as defined in claim 29, wherein said foodstuff is partially cooked prior to introducing the foodstuff into the container.

31. A method as defined in claim 29, which comprises subjecting the foodstuff to conditions such that the acid-pasteurization of the foodstuff is effected.

32. An acid-stabilized foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, prepared by a method which comprises treating the foodstuff with a polymeric food-acceptable acid under conditions such that the foodstuff is acid-stabilized.
33. An acid-stabilized foodstuff as defined in claim 32, wherein said polymeric food-acceptable acid is alginic acid.
34. An acid-stabilized foodstuff as defined in claim 32, wherein said method comprises cooking said foodstuff in an aqueous solution or suspension of said polymeric food-acceptable acid.
35. An acid-stabilized foodstuff as defined in claim 34, wherein said aqueous solution or suspension of at least one polymeric food-acceptable acid has a pH from about 2.4 to 2.8.
36. An acid-stabilized foodstuff as defined in claim 34, wherein said acid is alginic acid.
37. An acid-stabilized foodstuff as defined in claim 34, wherein at least one other food-acceptable acid is dissolved or suspended in the aqueous solution or suspension of at least one polymeric food-acceptable acid.
38. An acid-stabilized foodstuff as defined in claim 34, wherein the foodstuff is subjected to conditions such that the foodstuff is in an acid-pasteurized state.

39. An acid-stabilized foodstuff as defined in claim 34, wherein the foodstuff is subjected to conditions such that the foodstuff is in a precooked state.

40. An acid-stabilized foodstuff as defined in claim 34, wherein said cooking is under conditions such that said foodstuff has a pH below about 4.6.

41. An acid-stabilized foodstuff as defined in claim 40, wherein said cooking is under conditions such that said foodstuff has a pH from about 3.8 to 4.2.

42. An acid-stabilized foodstuff as defined in claim 41, wherein said cooking is under conditions such that said foodstuff has a pH of about 4.0.

43. An acid-stabilized foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, which is substantially free of any foreign acid flavor notes.

44. An acid-stabilized foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, which has a pH of 6.0 or below, and includes at least one polymeric food-acceptable acid component.

45. A shelf-stable foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast

puddings with cereal grains, which has a pH below about 4.6, and at least one polymeric food-acceptable acid component.

46. A shelf-stable foodstuff as defined in claim 45, wherein said foodstuff has a pH from about 3.8 to 4.2.

47. A shelf-stable foodstuff as defined in claim 45, wherein said foodstuff has a pH of about 4.0.

48. A shelf-stable foodstuff as defined in claim 45, which is in a precooked state.

49. A shelf-stable foodstuff as defined in claim 45, wherein each polymeric food-acceptable acid is selected form the group consisting of alginic acid, pectinic acid, carrageenic acid and carboxymethylcellulose acid.

50. A shelf-stable foodstuff as defined in claim 49, wherein said polymeric food-acceptable acid is alginic acid.

51. A shelf-stable foodstuff as defined in claim 45, which further comprises at least one other food-acceptable acid component.

52. A shelf-stable foodstuff as defined in clam 51, wherein each said other food-acceptable acid component is selected form the group consisting of citric, malic, acetic, fumaric, tartaric, phosphoric, adipic, lactic, ascorbic, sorbic, propionic, erythorbic, sulfuric and hydrochloric acids.

53. A shelf-stable foodstuff as defined in claim 51, which has a pH below about 4.6, and at least one polymeric food-acceptable acid component as well as at least a citric acid component.

54. A shelf-stable foodstuff as defined in claim 45, which further comprises an amount of edible oil sufficient to prevent the foodstuff from sticking together.

55. A shelf-stable foodstuff as defined in claim 54, wherein said amount of edible oil is from about 0.5 to 1% by weight of the foodstuff.

56. A system which comprises an acid-stabilized foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, which is substantially free of foreign acid flavor notes, and a container in which the foodstuff resides.

57. A system which comprises an acid-stabilized foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, having a pH of 6.0 or below, and including at least one polymeric food-acceptable acid component, and a container in which the foodstuff resides.

58. A system which comprises a shelf-stable foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noddle puddings and breakfast puddings with cereal grains, having a pH below about 4.6, and at least one polymeric food-acceptable acid component, and a container in which the foodstuff resides.

59. A system as defined in claim 58, wherein said foodstuff has a pH from about 3.8 to 4.2.

60. A system as defined in claim 59, wherein said foodstuff has a pH of about 4.0.

61. A system as defined in claim 58, wherein each polymeric food-acceptable acid is selected from the group consisting of alginic acid, pectinic acid, carrageenic acid and carboxymethyl cellulose acid.

62. A system as defined in claim 58, wherein said foodstuff includes an alginic acid component.

63. A system as defined in claim 58, which further comprises at least one other food-acceptable acid component.

64. A system as defined in claim 63, wherein each said other food-acceptable acid component is selected from the group consisting of citric, malic, acetic, fumaric, tartaric, phosphoric, adipic, lactic, ascorbic, sorbic, propionic, erythorbic, sulfuric and hydrochloric acids.

65. A system as defined in claim 58, wherein said other food-acceptable acid component includes citric acid.

66. A system as defined in claim 58, wherein said container is microorganism-impermeable, waterproof, or both microorganism-impermeable and waterproof.

67. A system as defined in claim 58, wherein said container is a plastic tray or pouch.

68. A system as defined in claim 67, wherein said plastic pouch comprises a laminate of a reinforcing layer and a sealing layer.

69. A system as defined in claim 58, wherein the foodstuff is under vacuum within the container.

70. A system as defined in claim 58, wherein the foodstuff resides in an inert atmosphere within the container.

71. An acid-stabilized foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, prepared by acidifying the foodstuff with an aqueous solution or suspension of at least one polymeric food-acceptable acid in a quantity sufficient to provide said foodstuff having a pH below about 4.6.

72. An acid-stabilized foodstuff as defined in claim 71, wherein said at least one polymeric food-acceptable acid is present in the foodstuff.

73. An acid-stabilized foodstuff as defined in claim 71, further prepared by heat-pasteurizing the foodstuff.

74. An acid-stabilized foodstuff as defined in claim 72, further prepared by heat-pasteurizing the foodstuff.

75. A method for the preparation of an acid-stabilized foodstuff selected from the group consisting of processed vegetables, processed fruits, vegetable beverages, fruit beverages, fruit gels, cheesecake, sauces containing meat, rice puddings, noodle puddings and breakfast puddings with cereal grains, which comprises introducing a polymeric food-acceptable acid, in an amount sufficient to effect acid-stabilization of the foodstuff, during formulation of the foodstuff.

76. A method as defined in claim 75, further comprising heat-pasteurizing the foodstuff.

77. A method of preparing a foodstuff for consumption, which comprises heating a product as defined in claim 43.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/08359

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): A23B 7/10

U.S. CL: 426/321, 325

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U. S.	426/268,321,324,325,407,412,521

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X Y	US, A, 4,504,504 (GAEHRING ET. AL.) 12 MARCH 1985. See the entire document.	1,32,33,75,76 1-22,28-65 and 71-77
Y	US,A, 4,959,230 (WYSS ET. AL.) 25 SEPTEMBER 1990 See Col. 2, lines 9-44.	1-22,28-65,and 71-77
Y	PATENT ABSTRACTS OF JAPAN, Vol. 12, NO. 209 issued 15 JUNE 1988 (JP, A, 63-007770 (NIPPON KAYAKU CO., LTD) 27 JUNE 1986). See the entire abstract.	1-22,28-65 and 71-77
Y	CA, A, 1,071,920 (BROOKS ET. AL.) 19 FEBRUARY 1980. See page 4, lines 10-30; page 5, lines 1-30, and pg 6, lines 1 and 2.	1-22,28-65 and 71-77
Y	JP, A, 59-42838 (NIPPON SUISAN KAISHA) 9 MARCH 1984. See the abstract	23-27 and 60-67

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
13 JANUARY 1992	18 MAR 1992
International Searching Authority	**Signature of Authorized Officer**
ISA/US	ANTHONY WEIER

Form PCT/ISA/210 (second sheet) (Rev. 11-87)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	JP, A, 58-81735 (TOYO SEIKAN KAISHA) 17 MAY 1983. See the abstract.	1-77
A	JP, A, 59-216542 (KUMABE) 6 DECEMBER 1984. See the abstract	1-77

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ____ because they relate to subject matter [2] not required to be searched by this Authority, namely:

2. ☐ Claim numbers ____ because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [3], specifically:

3. ☐ Claim numbers ____, because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [4]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.